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(54) **CROSS BAND GRINDING MACHINE FOR TWO-SIDED BEVELING OF THE EDGE OF
GLASS PLATES**

(57) A cross band grinding machine for trimming the edges of glass plates includes two driven grinding belts (20, 22) that circulate in each case around two parallel rollers (24, 26; 66), the grinding surfaces of which belts are, in each case in opposite manner, inclined approximately 45° relative to the plane of the glass plate to be trimmed and are arranged one behind another in the movement direction of the glass edge. The two grinding belts (20, 22) are arranged on a carriage (10) that is movable perpendicularly to the glass edge. One of the grinding belts (22) is displaceable in relation to the other on the carriage perpendicularly to the glass edge, and sensors are provided for determining and controlling the positioning of the grinding belts.

DE 44 19 963 C 1

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DESCRIPTION

The invention relates to a cross belt grinding machine for two-sided beveling of the edge of a glass plate by two belt grinding units, which display grinding belts circulating around two rollers in each case, the grinding surfaces of which belts are inclined, in opposite manner in each case, by approximately 45° to the plane of the glass plate to be beveled and are arranged one behind the other in the feed direction of the glass plate.

US 3 800 477 shows and describes a belt grinding machine for the edge planing or beveling, as the case may be, of the edges of glass plates. The grinding machine is evidently aimed toward the grinding of glass plates with curved, irregular edges, as for example motor-vehicle windshield panes. At the two opposing edges of a feed section for glass plates are located mutually-crossing belt grinding units, which are suspended in a swinging manner in order to adapt to different glass plate shapes. The grinding planes of the grinding belts run more or less obliquely to the feed direction, so that the grinding belts can be pushed apart in a swinging manner by the incoming glass plates, and this even when a glass plate meets the belts with the leading edge. The belts should consist of very flexible and tough material and be able to place themselves around the corners of the glass plate against the edges of the glass plate.

The contact pressure, which depends on the swinging position of the belt grinder unit, is in this design inevitably irregular. In addition, since the system can only be functional if the grinding belt material is very flexible and soft and deforms according to the course of the glass-plate edge, an adequate service life is not achievable. Beyond that, the obviously high structural expense does not appear to be justifiable or sensible, at least in the case of simpler grinding tasks, as for example the lateral beveling of rectangular glass plates.

While according to the above-described US patent specification the beveling of the glass-plate edges serves primarily to eliminate a risk of injury to the personnel in the further processing of the glass plates, the beveling also of plate glass in large tables, for example in the standard formats of 6.0 to 3.21 m, is suitable or even necessary. Above all in the case of thermal aftertreatment, for example in the production of mirrors or in the production of laminated plane glass, due to thermal forces or due to mechanical loads spontaneous breakings can occur, which breakings generally have their origin in small dish-shaped defects, break-offs, or hairline cracks at the edge of the glass, which can be caused by a diamond cutting wheel or, as the case may be, the breaking off during the cutting to shape of the table. It has become evident that these, often very small, irregularities on the edges of the glass tables can be eliminated through beveling of the glass edges

with the aid of cross belt grinding machines. However, a satisfactory solution for the automatic beveling of glass tables did not exist until now.

The system that has been described in the above-mentioned US patent specification is not suitable for the stated purpose, since it does not make possible a constant contact pressure of the grinding belts and the service life of the grinding belts, which must be continually deformed not only in the circulation around the rollers, but also transversely to the belt surface, is necessarily short. Beyond that, the high structural cost of the known design for the beveling of essentially rectangular glass tables is not justifiable. Thus, it is today still largely normal to manually guide the glass tables against the grinding belts of a fixedly-arranged cross belt grinding machine. This naturally leads to a high labor requirement and, beyond that, also to an irregular contact pressure with correspondingly irregular ground edges.

The invention is based on the task of creating a cross belt grinding machine that has a relatively simple structural design and, especially in the case of beveling of essentially rectangular glass plates, makes possible a long service life of the grinding belts.

In order to accomplish this task, the cross belt grinding machine according to the invention is characterized in that the belt grinding units are arranged on a common carriage that is movable perpendicularly to the glass plate edge, that one of the belt grinding units is displaceable on the carriage in relation to the other perpendicularly to the glass plate edge, and that sensors are provided for controlling the advancing motion of the belt grinding units.

According to the invention, taken into account through the displaceable arrangement of both cross belts is the fact that the glass plates may not be feed in an absolutely positionally-exact manner. According to the invention, a manual adjustment is not necessary, since the sensing of the glass plate edge and the precise adjustment of both grinding belts takes place completely automatically.

Here, the two grinding belts are preferably only applied when the incoming glass plate has reached the working region of the respective grinding belt. Achieved through this staggered application control is that the front glass edge cannot collide with one of the two side edges of the grinding belts.

In this context, it is appropriate to arrange the belt grinding unit arranged fixedly on the carriage such that this unit is reached first by the glass plate, and to let the grinding belt that is movable on the carriage follow in the feed direction of the glass plate movement. In this way, the second grinding belt can be adjusted on the carriage later according to the continuous plate movement.

A sensor-controlled adjusting, according to the invention, of the belt grinding unit results of course in the possibility of an exact setting of the grinding pressure, so that, relative to the prior art, a more precise processing can be achieved and the service life of the grinding belts can be considerably lengthened.

Finally, the separate, independent setting of the two belt grinding aggregates in relation to the glass edge makes it possible to take into consideration different glass thicknesses. In the case of a conventional grinding device, the height of the crossing point of the two belts remains fixed in relation to the height of the glass plate support. This inevitably means that only in the case of a predetermined glass-plate thickness can the upper and lower bevelings turn out equal. With increasing glass-plate thickness, the upper bevel becomes increasingly large in relation to the lower bevel. In contrast, according to the present invention, where the two belt grinding units can be put up against the glass plate separately from each other, an absolutely precise manner of processing is possible at both edges.

In the following, an embodiment example of the invention is explained in detail with the aid of the accompanying drawings.

Fig. 1 is a perspective, schematic representation of a cross belt grinding machine according to the invention.

Fig. 2 is a partial plan view, shown in reduced scale, in order to illustrate the position of the grinding machine in relation to a glass edge.

According to Fig. 1, a cross belt grinding machine according to the invention includes a carriage 10, on which a first belt grinding unit 12 and a second belt grinding unit 14 are arranged next to each other. The first grinding unit 12 is fixedly attached to the carriage 10, while the second grinding unit 14 is displaceable relative to the carriage 10 and the first grinding unit, as will be described in greater detail below.

Both grinding units 12, 14 display housings 16, 18, for example of sheet metal, the shape of which can be described as approximately C-shaped. In this way, the housings 16, 18 display notches, not shown on the side facing the viewer in Fig. 2, in which notches grinding belts 20, 22 are visible and freely accessible. The first grinding belt 20 rises, at its grinding surface visible in the corresponding notch, obliquely towards the rear, i.e. away from the viewer at an angle of approximately 45°. Beyond that, as can be seen with the dashed lines, the grinding belt 20 is designed as an endless belt that circulates around two rollers 24, 26, of which the roller 24 is drivable with the aid of a drive motor 28 via a belt transmission 30. The belt transmission 30 in-

cludes a belt pulley 33 attached to the output shaft of the drive motor 28, a belt pulley 34 attached to the shaft 32 of the roller 24, and a belt 36. The belt pulley 34 is situated on the shaft 32 between two bearing blocks 38, 40, in which the shaft 32 is supported outside the housing 16 on a bracket 42 attached to the housing. The bracket 42 and the belt transmission 30 are covered by a protective housing 44 indicated with dashed lines.

The lower roller 26 of the grinding belt 20 is supported on an axle 46, which likewise extends out of the housing 16 through an elongated hole 48 that extends parallel to the direction of the grinding belt 20. The axle 46 is supported in two bearing blocks 50, 52 that are fastened to a bracket 54, which in turn is attached to a sliding plate 56 that is displaceable parallel to the direction of the grinding belt 20 through sliding in guides 58 on the outside of the housing 16. The sliding plate 56 can be displaced with the aid of an air cylinder 60, which is likewise mounted on the outer wall of the housing 16. This air cylinder 60, together with the above-mentioned elements, forms a tensioning device for the grinding belt 20. This tensioning device facilitates a quick replacement of the grinding belt 20.

In order to lengthen the service life of the grinding belts 20, 22 and to improve the grinding structure, diamond grinding belts can be used in a wet grinding process. In order to moisten the grinding belt 20 and to cool the latter, spray nozzles 62, 64 are shown in Fig. 1 on both sides of the grinding belt 20.

In order to lengthen the service life of the very expensive diamond grinding belts, the rollers 24, 26 possess a relatively large diameter of, for example, 350 mm. Resulting from this are relatively large radiuses of curvature, which reduce the mechanical stressing of the grinding belts. Large rollers also facilitate the setting of a high belt running speed of, for example, 50 m/second or above, which results in a decisive improvement of the grinding structure and likewise a lengthening of the service life.

The second grinding unit 14 accommodates the grinding belt 22 in its housing 18, which belt, as opposed to grinding belt 20, rises towards the viewer at an angle of approximately 45°. In Fig. 1, only the upper, driven roller 66 of the grinding belt 22 with its shaft 68 is shown. This shaft 68 is in turn connected to a drive motor 70, in a manner not shown in detail, via a belt transmission 72, which is covered by a protective housing 74. These parts largely correspond to the previously-described drive motor 28, belt transmission 30, and protective housing 44 of the first grinding unit 12.

As in the case of the first grinding belt 20, situated on both sides of the second grinding belt 22 are spray nozzles 76, 78 for carrying out the wet grinding.

The second grinding unit 14, in contrast to the first grinding unit 12, is not fixedly attached to the carriage 10, but rather displaceably on the carriage along rails 80 with the aid rollers 82. Fastened to the housing 16 of the first grinding unit 12 is a support plate 84, which extends towards to side of the neighboring grinding unit 14. Fastened to the cantilevered region of the support plate 84 is a pneumatic cylinder 86, the piston rod 88 of which is connected to an intermediate rod 90. This intermediate rod 90 is generally situated in a stationary position in relation to the housing 18 of the second grinding unit 14, but can be shifted in the longitudinal direction with the aid of an adjustment mechanism 92. Through this, the stroke distance of the pneumatic cylinder 86 shifts. The adjustment mechanism 92 serves the adjustment to different glass thicknesses.

Fig. 2 illustrates the manner of operation of the machine shown more precisely in Fig. 1. Shown in plan view are the carriage 10 and the two belt grinding units 12 and 14 on the carriage 10. The carriage 10 can move according to the wide arrow 1 from the shown position into the position indicated by dashed lines. On the carriage 10, the grinding unit 14 can likewise be displaced into to the position shown in dashed lines. This movement is indicated by the narrow arrow 2. A glass plate 94 is moved on a conveyor 96 in the direction of arrow 3.

In its application motion, the displaceable grinding belt 22 moves against an adjustable stop (not shown in the drawings). Through this adjustment of the stop, an adaptation to a particular glass plate thickness is possible.

PATENT CLAIMS

1. Cross belt grinding machine for two-sided beveling of the edge of a glass plate (94), having two belt grinding units (12; 14), which display grinding belts (20; 22) circulating around two rollers (24, 26; 66) in each case, the grinding surfaces of which belts are inclined, in opposite manner in each case, by approximately 45° to the plane of the glass plate (94) to be beveled and are arranged one behind the other in the feed direction of the glass plate (94), **characterized in that** the belt grinding units (12; 14) are arranged on a common carriage (10) that is movable perpendicularly to the glass-plate edge, that one of the belt grinding units (12; 14) is displaceable on the carriage (10), in relation to the other unit, in a manner perpendicular to the glass-plate edge, and that sensors are provided for controlling the advancing movements of the belt grinding units (12; 14).
2. Cross belt grinding machine according to claim 1, characterized in that, with reference to the feed direction of the glass plate (94), the second belt grinding unit (14) is movable on the carriage (10).
3. Cross belt grinding machine according to claim 1 or 2, characterized in that the sensors are provided for detecting the glass-plate front edge and the glass-plate rear edge running transversely to the feed direction, which sensors control the advancing of the belt grinding units (12; 14) in such a way that the belt grinding units (12; 14) are individually and sequentially advanced to the passing glass-plate edge only once the glass plate (94) lies in the working region of the respective belt grinding units (12; 14).

2 pages of drawings accompany this